Zebra Mussel Abatement

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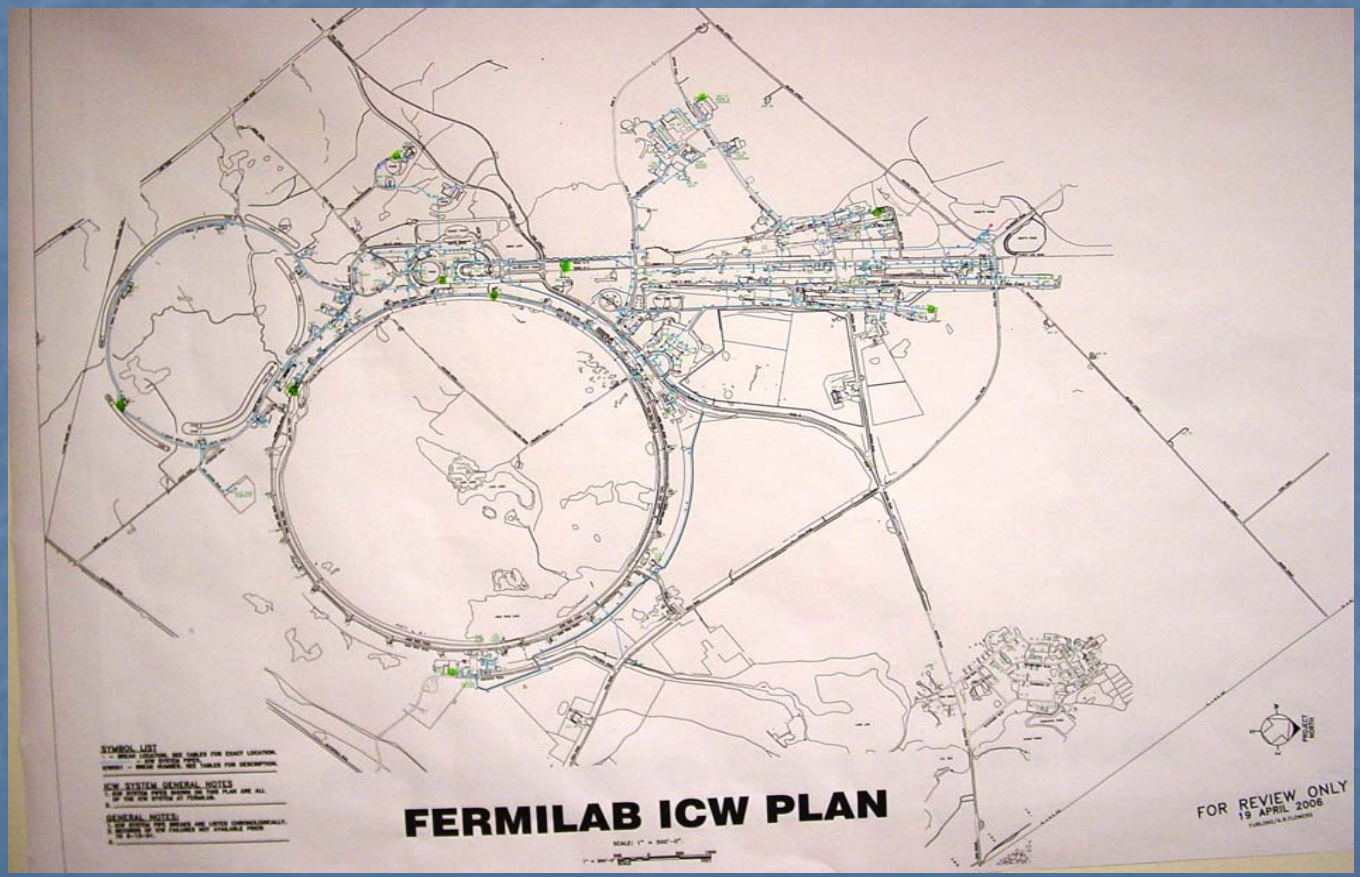
Steps in Project

- Determine BEST method of abatement
- Align System for Introduction Phase
- Inject EVAC into system at Casey's Pond
- Monitor System for flow and concentration
- Monitor System for signs of mussel separation
- Begin/Continue Flush until cleared of shells

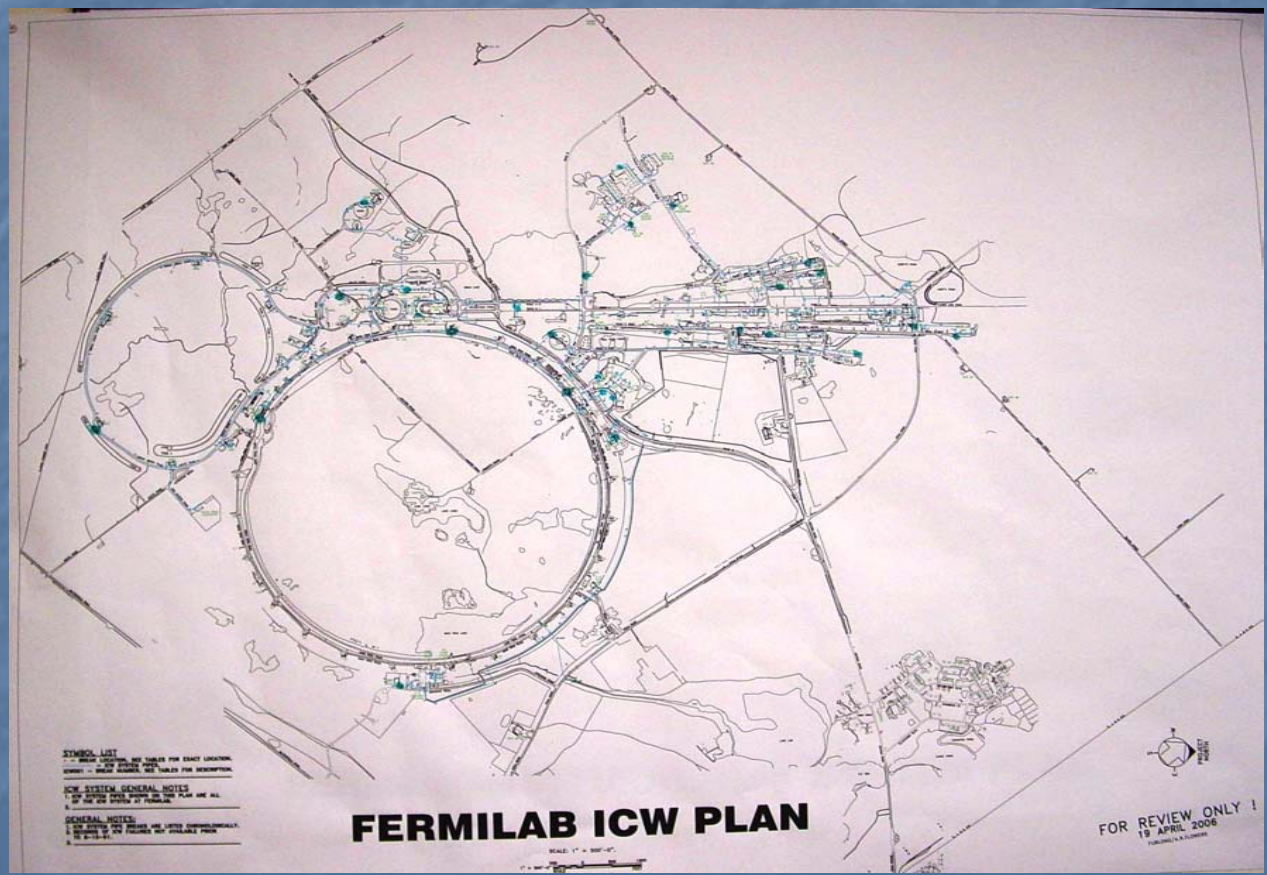
Potential Methods…

- Chemical molluscicides: Oxidizing (chlorine, chlorine dioxide) and Non-oxidizing
- Manual removal (pigging, high pressure wash)
- Dewatering / Desiccation (freezing, heated air)
- Thermal (steam injection, hot water >32°C)
- Acoustical vibration
- Electrical current
- Filters, Screens
- Coatings: Toxic (copper, zinc) and Non-toxic (silicone-based)
- Toxic constructed piping (copper, brass, galvanized metals)
- Carbon dioxide injection
- Ultraviolet light
- Flushing

Align System for Introduction Phase



Inject EVAC into System at Casey's Pond



Injection Skid

Monitor System for Flow and Concentration

Lessons Learned

Realignment needed to achieve accurate dosing in:

- Main Injector
- Main Ring/Tev
- Area Near Cross Gallery

Changes Resulting in Successful Completion of Introduction Phase

- 3 new hydrant flows introduced to induce accurate flow and dosing
- 60% increase in testing originally planned – to provide more data to benefit future treatment
- EVAC concentrations following this phase lower than anticipated (by 25%)
- Separation of shells progressing slower than anticipated due to lower water temps

Lessons Learned

- Flow is not even throughout system and changes to original procedure were necessary.
- Extra care needed on out flows from FCC and Industrial Buildings to eliminate/reduce fish kill in Bull Rush Pond and Proton Ditch.

Monitor System for signs of Mussel Separation

Begin/Continue Flush Until Cleared of Shells

- Pre-Flush department briefings
- 24/7 flushing by shop to minimize clogging
- Due to careful pre-planning and constant flushing no clogging occurred.

Results of Flush

3,000# removed from pipes
10,200# removed from intake

Heavy concentrations in:

- Fixed Target
  - Meson Central Cryo/LLRW
  - TPL
  - PB6 & PB7
  - Labs A-G
- New Muon
- CHL & IB1A
- Reflecting Pond
- Cross Gallery

Results of Flush (con't)

- Smaller Shell Sizes at New Muon – somewhat uniform first flush
- Very large sizes found near Wilson Hall (5-6 years old)
- General mix in size throughout site

Moving Forward

- Twice a year treatment will keep all at bay and further issues with shells will not be an issue……will be transparent to user.
- Overall we were successful even though we had some problems. Moving forward we will learn from our successes and issues – of course, we continue to learn.
- Watching for new/better technologies for zebra mussel abatement.